Soil biodiversity increases plant productivity resistance and recovery to drought in grassland communities

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Résumé

Drought events are expected to increase in frequency and severity due to the undergoing climate change. Plant growth in term of biomass productivity is affected by drought in various ways including death and reduced or delayed growth. However, this expected decrease in plant productivity due to drought events might be balanced by the buffering effect of diversity of plants and soil organisms thanks to mechanisms of complementarity and facilitation. Focusing on eight perennial fodder grassland plant species with contrasting ecological strategies, this study aimed at exploring the buffering effects of plant species mixture and soil biological diversity on the inter-seasonal patterns of plant productivity during and after a moderate early-summer drought. We hypothesized that plant and soil biological diversity would increase both the grassland productivity during and after drought, as well as its stability across seasonal harvests. We further expected that the functional diversity in key functional traits associated to plant resistance and recovery in the face of drought would drive this stability.

To do so, a full-factorial experiment of 240 mesocosms with two species richness (one *vs.* six species), two soil biodiversity (poor *vs.* biologically-enriched mesocosms) and two water treatments (drought *vs.* ambient) was run for 15 months with four sequential aboveground biomass harvests. Plants were characterized by a range of above- belowground, as well as mycorrhizal traits.
As expected, plant diversity strongly increased productivity (net biodiversity effect of +30%) with increasing effects over time, whereas soil biodiversity decreased plant productivity (-24%), in link with a much higher diversity and abundance of root-parasitic nematodes colonizing roots of most species. Water limitation negatively affected productivity (-22%) during the drought event, but this reduction was fully compensated by over-production in the two following harvests occurring the same year. Only soil biological diversity increased the resistance and recovery of production to drought whereas plant diversity had a negative effect on the short-term recovery and a positive effect on the resistance to the second drought event. Therefore multiple components of diversity can act as a buffer against climatic extremes to maintain the level of ecosystem functioning. Finally, comparing plant communities allowing high production during *versus* after the drought event highlighted a range of traits with potential role in resistance versus recovery to drought, respectively. Overall, our study suggests that the diversity of plant ecological strategies and soil biota play a key role in driving the general level of functioning of ecosystems and their stability.

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Mots-Clés: plants, grassland, drought, diversity, stability, resistance, recovery, biodiversity, ecosystem functioning